

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 :
G08B 17/113

A1

(11) International Publication Number: WO 00/58924

(43) International Publication Date: 5 October 2000 (05.10.00)

(21) International Application Number: PCT/GB00/01150

(22) International Filing Date: 27 March 2000 (27.03.00)

(30) Priority Data:
9906784.5 25 March 1999 (25.03.99) GB

(71) Applicant (for all designated States except US): RUNNER & SPRUE LIMITED [GB/GB]; The TechnoCentre, Puma Way, Coventry CV1 2TT (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): RUTTER, Nicholas, Alexander [GB/GB]; The TechnoCentre, Puma Way, Coventry CV1 2TT (GB). TATE, Simon, Paul [GB/GB]; The TechnoCentre, Puma Way, Coventry CV1 2TT (GB).

(74) Agent: HALLAM, Arnold, Vincent; Lewis & Taylor, 5 The Quadrant, Coventry CV1 2EL (GB).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

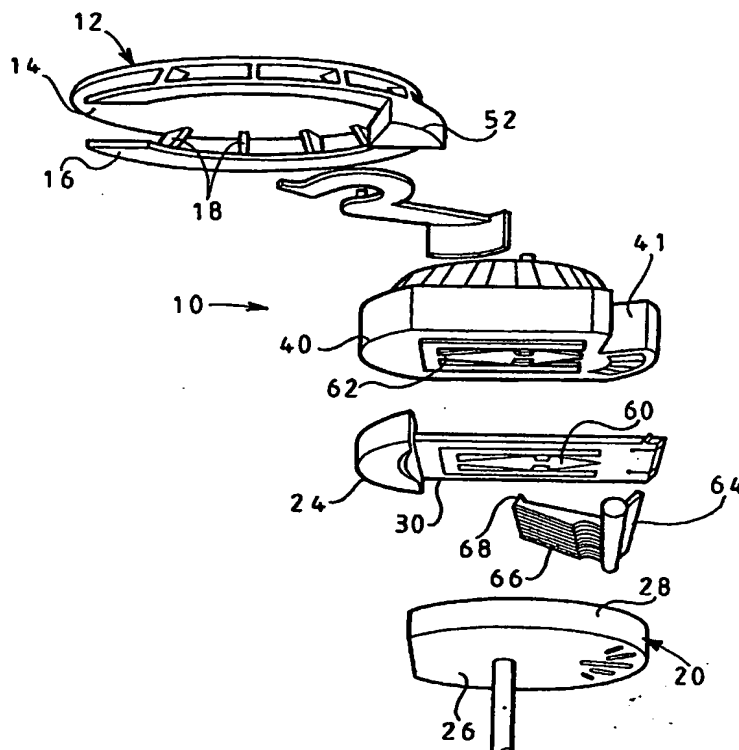
With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: SMOKE DETECTOR HOUSING

(57) Abstract

An alarm for detecting radiation and/or pollutants such as smoke, carbon monoxide, methane, radon or the like comprises a housing and detection means removably mounted in the housing. The detection means is contained within a cartridge adapted to be seated on a tray which is slidably mounted within the housing such that the tray can be easily inserted and withdrawn from the housing to enable easy replacement of the cartridge.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LJ	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

SMOKE DETECTOR HOUSING

The present invention relates to an alarm for detecting radiation and/or air pollutants such as smoke, carbon monoxide, methane, radon or the like.

5 It is known that contamination of detecting circuitry in a smoke alarm or the like, for example by dust or dirt, can occur with the result that the sensitivity of the smoke detection circuitry is compromised. Consequently, it is recommended that such circuitry is replaced on a regular basis, for example every ten years.

10 A disadvantage associated with existing detectors is that they are often provided with the detection circuitry fixedly mounted to an outer housing as a single integrated unit. Replacement of the detection circuitry therefore necessitates replacement of the entire unit which, as the unit is normally mounted to a room ceiling by means of screws or the like, is often a complicated and time-consuming process.

The present invention seeks to provide an improved alarm.

15 Accordingly, the present invention provides an alarm for detecting radiation and/or pollutants such as smoke, carbon monoxide or the like having:

housing means; and

detection means;

wherein the detection means is removably mounted in said housing means.

20 Preferably said housing means comprises an upper housing member and a base, the upper housing member and the base being adapted to be fitted together.

Advantageously, the base comprises support means and carrier means slidably mounted on the support means, the carrier means being for seating the detection means thereon thereby to permit easy removal of the detection means.

The present invention will now be described, by way of example only, with reference to the
5 accompanying drawings in which:

Figure 1 is a perspective view of a preferred form of alarm according to the present invention in disassembled form;

Figure 2 is a first inverse plan view of a base of the alarm of figure 1;

Figure 3 is a second inverse plan view of the base of figure 2;

10 Figure 4 is a perspective view, partly in section, of the alarm of Figure 1 in partly assembled form;

Figure 5 is a perspective view of the alarm of Figure 1 in fully assembled form; and

Figure 6 is a circuit diagram of a reset/test circuit for the alarm.

Referring to figures 1-3, there is shown a preferred form of alarm 10 according to the present
15 invention. In this embodiment, the alarm 10 is a smoke alarm and is intended to replace a conventional ceiling rose for an electric light fitting. Conveniently, therefore, the alarm is powered by the electricity supply to the light fitting. A back-up battery is also provided for use during times when the light fitting is switched off. The electricity supply is additionally used to charge the battery

20 The smoke alarm 10 has an outer housing comprising two portions 12, 20 adapted to be fitted together. The first part is an upper housing member 12 in the form of a substantially circular plate 14 which is intended to be mounted on a ceiling of a room by means of screws or the

like (not shown). The upper housing part 12 also has connecting means, in the form of a U-shaped strip 16, for connecting the two parts of the housing together. The strip 16 is rigidly connected to the plate by a plurality of struts 18 which extend downwardly from a lower face of the plate. The strip 16 and the plate 14 are thus connected in spaced apart relationship
5 with their planes being substantially parallel.

The second part of the housing is a base 20, a plan view of which is shown in Figures 2 and 3. The base 20 is formed in two parts, a supporting member 22 and a carrier 24. The supporting part 22 takes the form of a truncated circular plate 26 with a raised rim 28 extending around the curved part of its perimeter. The carrier part 24 takes the form of a
10 drawer or tray 30 which is mounted for sliding movement in to and out of the supporting part 22 in the direction of the arrow A. As can be seen from Figure 3, when the tray 30 is fully pushed into the supporting part 22, the base forms a closed circular plate with a rim extending fully around its circumference.

As best shown in Figure 4, the base 20 is adapted to be fastened to the upper housing portion
15 12 to form an outer housing assembly which is substantially circular in cross section and which has flat upper and lower surfaces defined by the outer surfaces of the plates 14, 26. The housing assembly is arranged such that the tray 30 of the base 20 is able to slide in and out of the housing assembly in the direction denoted by the arrow.

Referring back to Figure 1, the smoke alarm 10 includes a cartridge 40 containing smoke
20 detection circuitry, a battery and an alarm sounder (not shown). The cartridge 40 is fully self-contained and can, in fact, operate independently of the housing assembly. The cartridge 40 is adapted to be seated on the tray 30 of the base 20 such that it can be pushed into and drawn out of the housing assembly.

The cartridge 40 has a recess 41 for engagement with electrical connection means provided
25 in the housing assembly as described below. The cartridge 40 has on its upper surface two coaxial, truncated cones 42, 44 each having a plurality of windows 46 disposed equidistantly around their circumferences. The inner cone 42 is fixed relative to the upper surface of the

lower portion of the cartridge 40 whereas the outer cone 44 is rotatable relative to the inner cone 42 and to the upper surface. As the outer cone is rotated relative to the inner cone, the windows 46 in the cones are alternately aligned and disaligned depending on the relative positions of the two cones. Alignment of the windows of the cones 42, 44 provides a plurality of openings into the cartridge for the passage of smoke.

It is preferable, before the cartridge 40 is inserted into the housing assembly, that the windows are disaligned such that no openings into the cartridge are provided. This is to ensure that the smoke detection circuitry within the cartridge 40 is not contaminated by dirt or dust prior to its insertion in the housing assembly.

In order to align the windows 46 in the cones 42, 44 when the cartridge 40 is inserted in the housing assembly, the smoke alarm 10 includes alignment means in the form of a spigot 48 extending upwardly from an upper surface of the outer cone 44, and an associated shoulder 50 formed in the upper housing member 12. As the cartridge 40, seated on the tray 30 is pushed into the housing assembly, the spigot 48 engages with the shoulder 50 and causes the outer cone 44 to rotate (anticlockwise in the drawings) relative to the inner cone 42 and thus align the windows to form the apertures into the cartridge 40.

As can be seen, therefore, the windows are aligned to provide the openings into the cartridge only as the cartridge is inserted into the housing assembly. This prevents the need for the openings to be formed prior to insertion of the cartridge in the housing, thus reducing the likelihood of contamination by dust or dirt of the smoke detection circuitry within the cartridge 40.

Referring to Figure 1, the upper housing member has connection means 52 for connecting the smoke alarm to an extended electricity supply. It will be appreciated that the external electricity supply may be that for powering the light fitting or any other external supply. The connection means 52 is adapted to engage in the recess 41 of the cartridge 40. A radially inner surface of the connection means includes plugs and/or sockets for coupling the electricity supply to the cartridge 40 as the cartridge is inserted into the housing. The

cartridge 40 has corresponding plugs/sockets which engage the plugs/sockets of the connection means 52.

To prevent a user accidentally touching the plugs/sockets of the connection means, the smoke alarm 10 includes isolating means in the form of an arm 54 which is connected to the underside of the upper housing member and is rotatable relative to the upper housing member about a pivot point 56. On one side of the pivot point, the arm extends in a substantially U-shaped portion 54a, the purpose of which is described below. On the other side of the pivot, the arm 54b extends radially outwardly and has at its end an arcuate flange 58 extending downwardly, perpendicular to the plane of the arm 54.

Before insertion of the cartridge 40 into the housing assembly, the flange 58 is aligned with the connection means 52 so as to cover the plugs/sockets and thereby isolate them from a user as shown in figure 4. As the cartridge is inserted into the housing by means of the tray 30, the rotation of the outer cone 44 caused by engagement of the spigot 48 with the shoulder 50 causes a second spigot 60 also extending perpendicularly upward from the upper surface of the outer cone 44 to engage in the U-shaped portion 54a of the arm 54.

As the cartridge is further inserted into the housing assembly, the second spigot 60, engaged in the U-shaped portion of the arm, causes rotation of the arm in the clockwise direction as shown in Figure 4 such that the flange 58 is rotated away from the connection means 52 thereby allowing the plugs and/or sockets to connect with the corresponding plugs and sockets on the cartridge 40.

If the cartridge 40 is withdrawn from the outer housing, the second spigot 60 engaged in the U-shaped portion 54a of the arm 54, causes the arm to rotate in the anticlockwise direction and thus draw the flange back in front of the connection means thereby to isolate the plugs and/or sockets of the connecting means from the user.

It can be seen that the present invention provides an alarm having the advantage that replacement of the detection circuitry is effected quickly and easily without necessitating

removal of the entire unit from the ceiling. This is achieved by providing the detecting circuitry in a discrete cartridge which is inserted into a housing assembly by means of a sliding tray and which connects with an electricity supply within the housing assembly.

Furthermore, since the cartridge 40 is fully self-contained, replacement of the cartridge means replacement of the electronic circuitry, battery and sounder providing optimum reliability for the alarm.

It will be appreciated, however, that the invention is not limited to an alarm for detecting smoke. The invention is equally applicable to an alarm for detecting radiation, for example heat (infrared) or the like, and/or for detecting gaseous air pollutants such as carbon monoxide, methane and radon or the like. Furthermore, a single cartridge may be adapted to have detection circuitry for detecting two or more of the above, for example smoke and carbon monoxide or smoke, heat and methane, or any other combination.

Various modifications and improvements can be made to the invention. For example, in order to ensure that only the correct type of cartridge is inserted into the housing assembly, the tray 30 can be formed with cut-outs or apertures 60 formed in it as shown in figure 1. The underside of the cartridge 40 can be formed with cooperating raised portions or protrusions 62 which match the shape and depth of the apertures 60 such that when the cartridge 40 is seated correctly on the tray 30, the protrusions are engaged in the apertures and the underside of the tray is thus uniform and smooth.

Locking means in the form of a rake 64 may be fixed in the base 20. The rake has prongs 66 inclined from the horizontal and pointing towards the direction from which the tray 30 is inserted. The prongs 66 have upturned teeth 68 which engage in the apertures 60. If a correct cartridge 40 is seated on the tray 30 with its protrusions 62 engaged in the apertures 60, the teeth 68 of the rake 64 bear upwardly on, and slide across, the uniform underside of the tray 30 as it is pushed into the housing assembly. If, however, an incorrect cartridge (having no/incorrect protrusions on its underside) is seated on the tray 30, the teeth 68 of the rake 64 engage in the apertures on the underside of the tray as it is pushed into the housing assembly

assembly so as to lock the tray and prevent it from being fully inserted.

Moreover, the protrusions on the cartridge and the apertures in the tray can be shaped to distinguish between, for example, a methane alarm and a smoke alarm. This ensures that only the correct type of cartridge can be used in a given alarm.

- 5 The alarm may also be provided with means for indicating when replacement of the cartridge should occur. This may be achieved by a simple electronic timer which measures the life of the cartridge and indicates, for example by means of an LED, when the unit has been in place for 10 years which is the recommended maximum life of a smoke alarm. Alternatively, the condition of the detection circuitry or the battery may be monitored to provide an indication
10 as to when the cartridge should be replaced.

If a timer is used it can be arranged to begin counting down only after the unit is inserted, energized, removed from its packing or otherwise actuated.

- Referring now to Figure 6, this shows a control circuit 140 which can be used to reset the smoke alarm. The circuit 40 has three flip-flops 142, 144, 146 which are arranged to provide
15 an output which is high in response to three input pulses on terminal three of the first flip-flop 142. Terminal three is connected to the output of the rectifier and filter unit 132 whilst terminal five of the flip-flop 142 is held high. The effect of this is that if the light switch providing power to the transformer 130 is flicked on and off rapidly three times the output of the counter circuit 148 formed by the flip-flops 142, 144, 146 goes high.

- 20 The output of the counter circuit 148 drives a relay 150 through a pair of MOS field effect transistors 152, 154, the relay in turn applying a reset signal to a logic device 154 which may be included in the reset circuit 138 or external to the reset circuit 138 and controlling the reset circuit in order to reset the alarm 136. As an alternative to the relay 150, the output of transistor 154 could be applied directly to the reset circuit 158 in order to reset the alarm.

- 25 Whilst three "flicks" of the light switch are used to reset the alarm, it will be appreciated that

this number may be varied and the time period during which the "flicks" must be effected can also be varied. In addition, a different number of "flicks" of the light switch could be used, through the logic device 154, to test the alarm or to perform an alternative function such as a change of mode of the alarm, for example to detect a different pollutant such as carbon monoxide.

As an alternative to the circuit of Figure 6 being actuated via a direct electrical signal from the charging circuit, it could be effected by way of a signal generated by a light sensor tripped by rapid ON and OFF switching of the light bulb.

During manufacture of the alarm, it is often the case that the battery supplied by the manufacturer may have a low charge. The alarm of the present invention is provided with circuitry which generates an audible warning from the buzzer 122 when the charge of the battery falls below a certain level. If the battery provided by the manufacturer already contains a low charge, during shipping of the unit it is possible that the audible low charge warning is constantly generated. This can be inconvenient and can further reduce the charge on the battery. It is preferable, therefore, to provide means for disconnecting, for example, the buzzer or the battery, from the circuitry during shipping. This may be achieved, for example, by providing a strip of non-conducting material such as polythene between either the buzzer or the battery and the circuit board. An end of the strip of non-conducting material projects out of the main housing of the alarm such that it can be pulled and withdrawn from between the buzzer and the circuit board prior to, or just after, insertion of the alarm into the ceiling rose light fitting. Once the alarm has been plugged into the light fitting, the lighting circuitry can be switched on such that a trickle charge is provided to the battery as described earlier, thereby to charge to the battery.

Alternatively, the alarm circuitry can be silenced in the above manner by building a short-circuit into the unit preventing the sounder from operating. This short circuit can, for example, be attached to a form of rip-cord which is removed before the cartridge is inserted. When the rip-cord is pulled the short circuit is permanently broken allowing the circuitry to function as intended. This gives the advantage of allowing the circuitry to be permanently

soldered giving greater durability.

Further more, rather than being manually actuated, the rip-cord can be actuated automatically (eg when the cartridge is inserted or removed from its packaging) or electrically (eg the short component is blown) and can also be combined with the actuator of the count down timer as
5 previously described.

An external sensitivity adjustment which is variable in discrete steps or continuously may also be provided on the alarm. Alternatively, to further reduce the degrading effect of heat on the performance and effectiveness of the detection circuitry, the sensitivity of the circuitry may be automatically adjustable such that as the temperature of the circuitry rises, its
10 sensitivity is increased. Thus any degradation in the performance of the detection circuitry is substantially compensated for by an increase in detector sensitivity.

Claims:

1 An alarm for detecting radiation and/or pollutants such as smoke, carbon monoxide or the like having:

housing means; and

5 detection means;

wherein the detection means is detachably mounted in said housing means.

2 An alarm according to claim 1 wherein said housing means comprises an upper housing member and a base, the upper housing member and the base being adapted to be fitted together.

10 3 An alarm according to claim 2 wherein the base comprises support means and carrier means slidably mounted on the support means, the carrier means being for seating the detection means thereon for insertion into the housing means.

4 An alarm according to any preceding claim wherein the detection means is contained within a cartridge.

15 5 An alarm according to claim 4 wherein the housing means includes first electrical connection means connectable to an external power supply and the cartridge includes second electrical connection means engageable with said first connection means for electrically connecting said cartridge to said power supply thereby to allow said detection means to be powered by said external power supply.

20 6 An alarm according to claim 5 wherein the housing means further includes cover means movable between first and second positions wherein:

in said first position said cover means restricts physical access to the first connection means and in said second position said cover means allows engagement of said first and second connection means.

7 An alarm according to claim 6 wherein said cover means is movable between said
5 first and second positions in response to insertion and removal of said cartridge into and from said housing means.

8 An alarm according to any preceding claim wherein the cartridge is provided with a plurality of apertures to allow the passage of said radiation and/or pollutants into the cartridge for detection by said detection means.

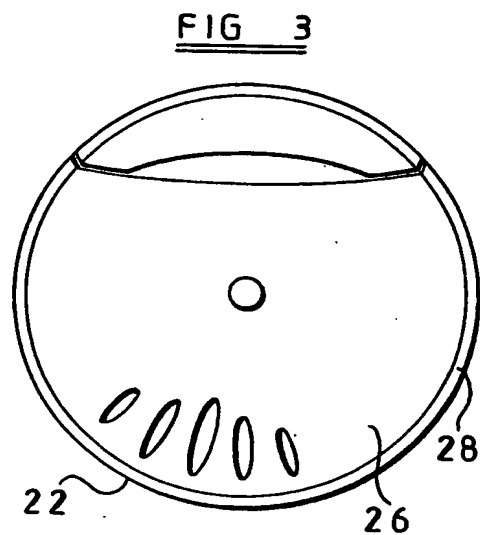
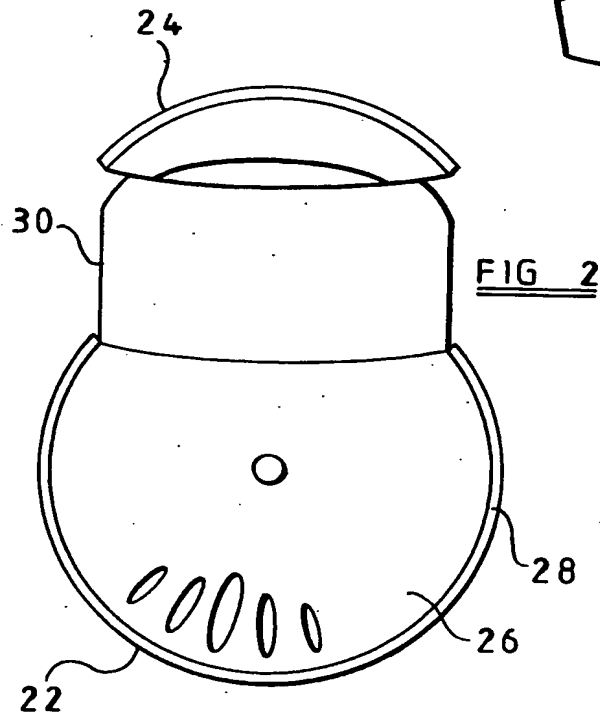
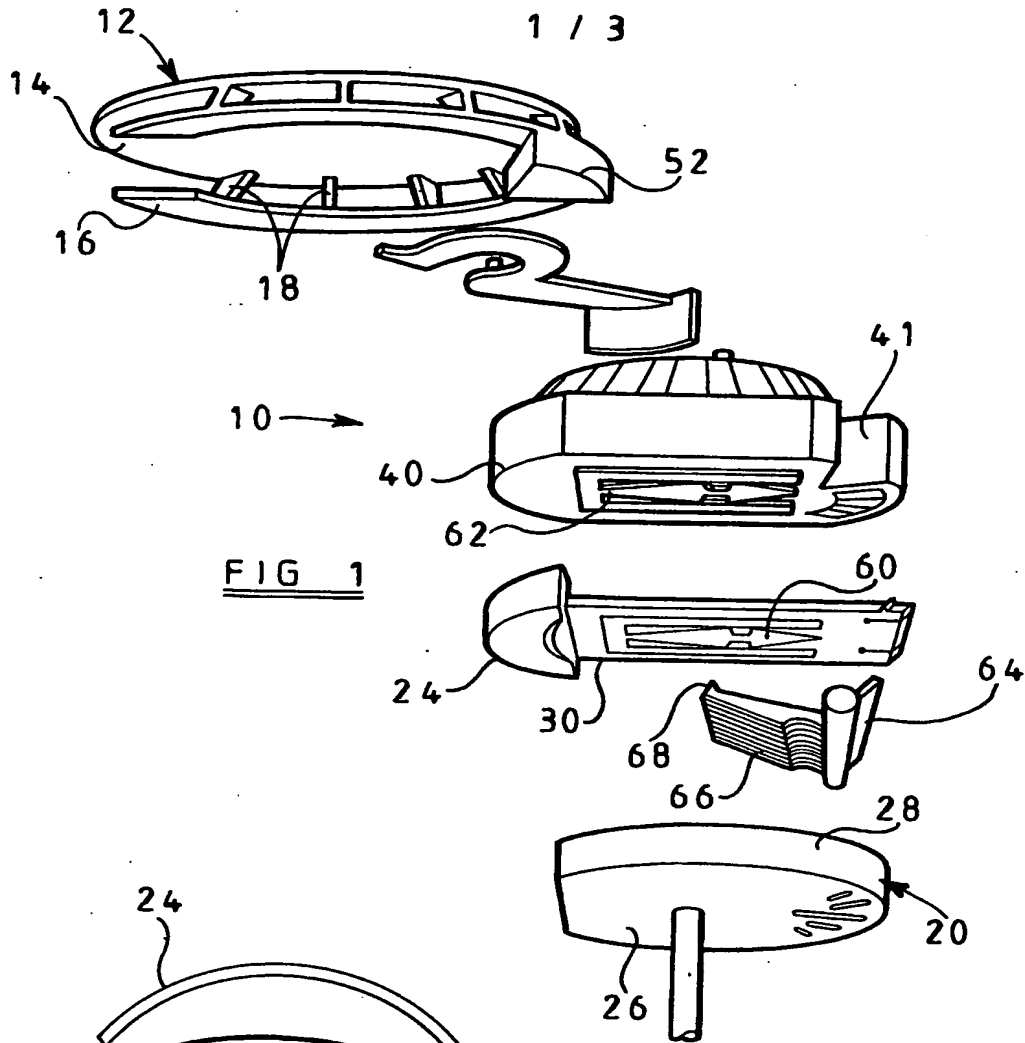
10 9 An alarm according to claim 8 wherein the cartridge is provided with closure means for closing said apertures, said closing means being means movable between first and second positions wherein:

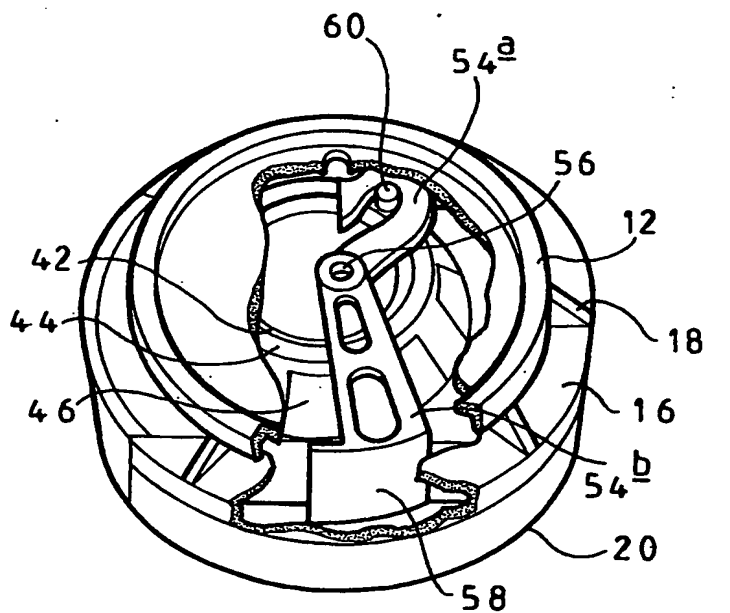
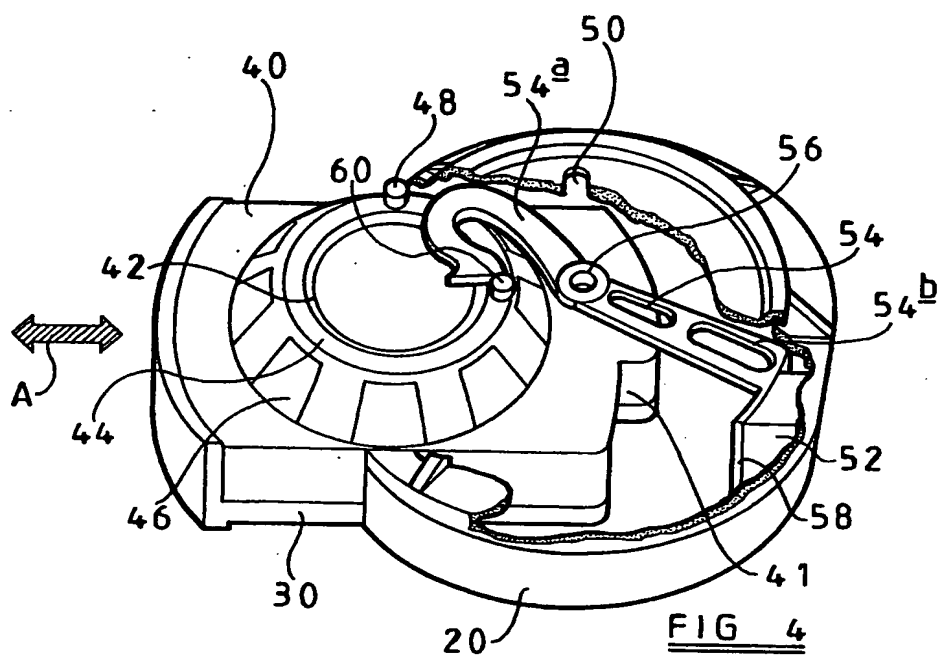
in said first position said closure means closes said apertures and in said second position said closure means opens said apertures.

15 10 An alarm according to claim 9 wherein said closure means is movable between said first and second positions in response to insertion and removal of said cartridge into and from said housing means.

11 An alarm according to any preceding claim having control means responsive to the energising and de-energising of the external power supply a preset number of times over a
20 preset time period to apply a reset signal to the alarm, thereby to reset the alarm in the event an accidental triggering thereof.

12 An alarm according to any preceding claim and having control means responsive to the energising and de-energising of the external power supply a preset number of times over a preset time period to apply a test signal to the alarm thereby to test the alarm.





3 / 3

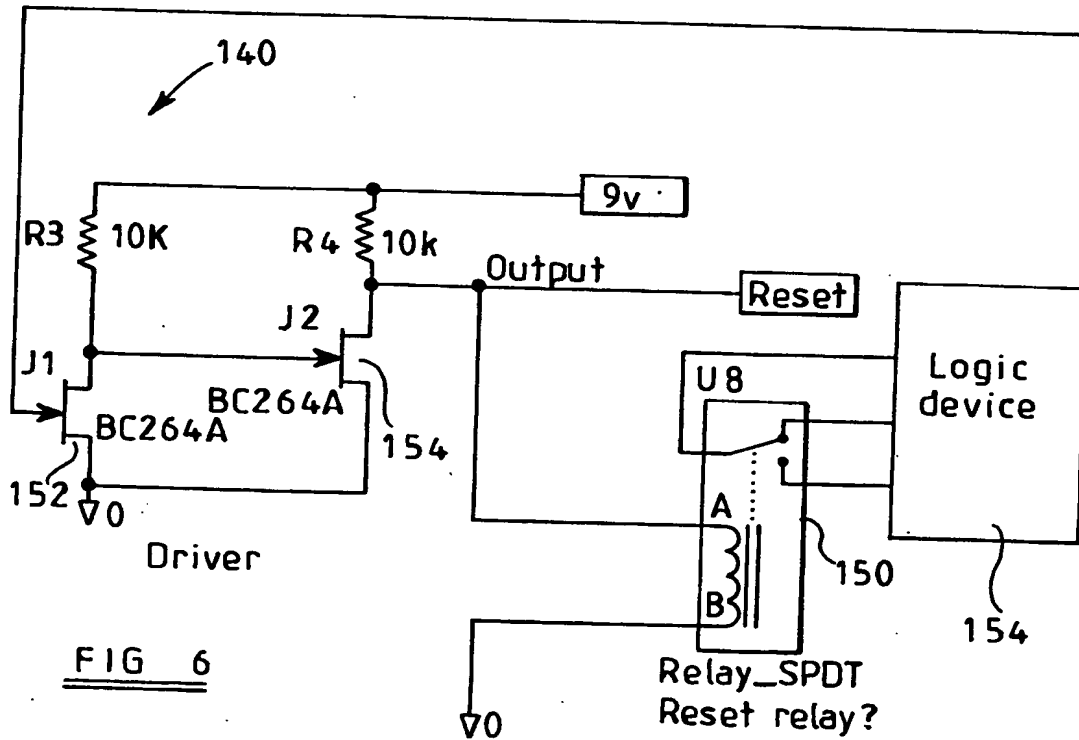
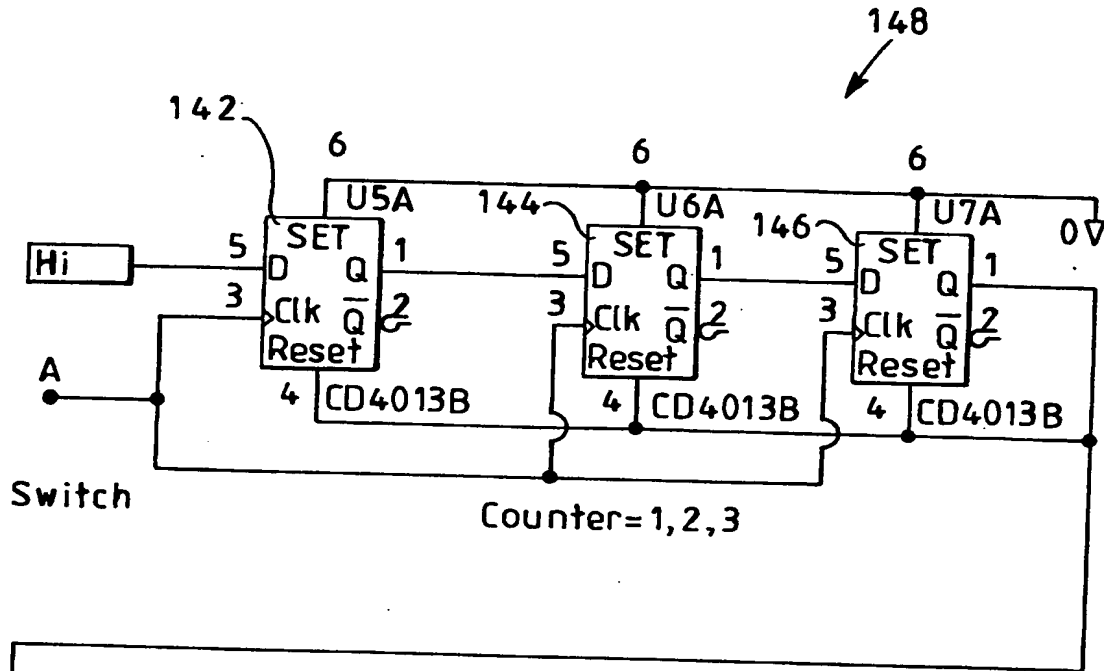


FIG 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/01150

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G08B17/113

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 280 273 A (GOLDSTEIN MARK K) 18 January 1994 (1994-01-18)	1-4,8,12
Y	column 3, line 10 - line 16 column 3, line 27 - line 36 column 4, line 16 - line 33	5-7,9,11
X	DE 197 33 375 A (HEKATRON GMBH) 4 February 1999 (1999-02-04)	1
Y	column 1, line 1 - line 12 column 1, line 61 - column 2, line 6	5-7
Y	US 4 384 488 A (SCHEIDWEILER ANDREAS) 24 May 1983 (1983-05-24) column 2, line 59 - column 3, line 4 claim 6	9
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"A" document member of the same patent family

Date of the actual completion of the international search

18 July 2000

Date of mailing of the international search report

26/07/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3018

Authorized officer

De la Cruz Valera, D

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/01150

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>US 5 432 500 A (SCRIPPS KEITH A) 11 July 1995 (1995-07-11) abstract</p>	11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/01150

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5280273 A	18-01-1994	EP 0604187 A JP 6317521 A	29-06-1994 15-11-1994
DE 19733375 A	04-02-1999	NONE	
US 4384488 A	24-05-1983	CH 648943 A AT 25438 T AU 541729 B AU 7011381 A CA 1150381 A DE 3175913 D DK 113281 A EP 0040342 A NO 811586 A,B, US 4475390 A	15-04-1985 15-02-1987 17-01-1985 12-11-1981 19-07-1983 12-03-1987 10-11-1981 25-11-1981 10-11-1981 09-10-1984
US 5432500 A	11-07-1995	AU 8081394 A WO 9512184 A	22-05-1995 04-05-1995